Conserving native bees on your land.

A guide for landholders on the North Coast of NSW

JALIIGIRR Biodiversity Alliance

Pollination and agriculture

Pollination is an essential reproductive process that helps maintain genetic diversity in plant populations, ensures the adequate production of seeds for reproduction, and stimulates the development of fruits to attract seed dispersers. The need to move pollen from flower to flower has also driven an extraordinary diversification in flower morphology and the co-evolution of numerous specialised animal pollinators.

Agricultural production is also highly dependent on pollination, and for the vast majority of species this means relying on animal pollinators. **Pollination by animals influences fruit set, size and quality for 39 of the 57 globally important commercial crop species, and within Australia the benefits of pollination services to agriculture are estimated to be between $4 to $6 billion per annum.**

Bees...perfect pollinators!

Although birds, bats and other mammals are valuable pollinators, insects, and in particular bees, are our most highly evolved and important group of animal pollinators.

Other insects, such as this Hoverfly, are also important pollinators of many crops and native plants.

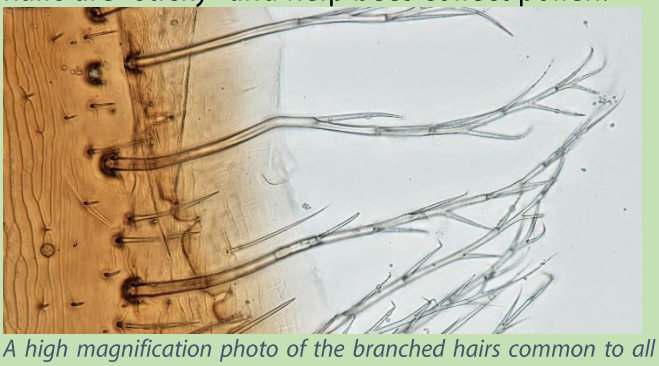
While the ubiquitous European honeybee (*Apis mellifera*) is familiar to almost everyone, many people are unaware that there are more than 20,000 bee species globally, with Australia having approximately 2000 species.

What are bees?

Bees are closely related to ants and wasps (Order: *Hymenoptera*) and are actually a type of specialised predatory wasp. **Whereas most predatory wasps prey on other insects, bees collect pollen and nectar to feed their larvae.**

An individual Leafcutter Bee brood cell showing the pollen ball and egg. When the egg hatches, the larvae consume the pollen before pupating, and eventually emerging as an adult.

Bees also have branched hairs – although you are unlikely to see them without a powerful microscope. These densely packed branched hairs are "sticky" and help bees collect pollen.



A high magnification photo of the branched hairs common to all bees (Photo: Terry Houston - WA Museum).

The Jaliigirr Biodiversity Alliance region occurs within the traditional lands of the Gumbaynggirr People. The word Jaliigirr comes from the Gumbaynggirr language and means "tree". The traditional and cultural connections of Gumbaynggirr People to this country extend over millenia and the Alliance appreciates and respects the complexity and value of these continuing practises.

The European honeybee

Since their introduction in the 1800's, European honeybees have become the most economically important pollinator for Australian crops. Such a heavy reliance on a single species of bee may be risky if new diseases or parasites, such as the Varroa mite, establish in Australia. The highly managed honeybee is very susceptible to these threats and any outbreak has the potential to severely disrupt the pollination of crops in this country.

European honeybees – common, but possibly over-rated. Inset: Varroa mite on a honeybee pupa (Photo: Gilles San Martin).

There are also instances where European honeybees are poor pollinators compared to many of our native bees. The inability of honeybees to "buzz pollinate" (see Buzz Pollination box) makes them less effective pollinators for many common crop plants such as tomatoes, eggplants and blueberries.

Even when native bees perform similarly to honeybees, they still provide an important pollination service. The use of multiple pollinators spreads the risk associated with the reliance on a single species, and crops pollinated by both honeybees and wild pollinators often have better fruit set than those visited by honeybees alone.

Australian bee diversity

Australia has a unique and diverse bee fauna ranging from the impressively large Yellow and Black Carpenter Bee (24mm) down to the tiny 1.8mm *Quasihesma* bees of Cape York, Queensland – the smallest bee in the world!

Estimates of the total number of bee species in Australia vary between 1500 and 3000. There are currently 1650 named species in Australia but there are also many more undescribed species. Our knowledge of the ecology of most of these species is even more limited, as many are known from only a few specimens.

Social vs solitary

The vast majority (99%) of Australian bees are solitary, meaning that each female builds and provisions a number of separate nest chambers (brood cells) to rear their young. This is usually done individually, although some species do occur in nest aggregations and may share nest-building tasks.

Multiple solitary bee brood chambers within a pithy stem.

Social bees by contrast live in complex colonies with a clear division of labour between different castes. Within Australia, there are only 10 species of "stingless" social bee, all in the genera *Tetragonula* and *Austroplebeia*. Stingless bees have attracted a lot of attention from amateur beekeepers since their domestication in the 1980's and are increasingly being used as crop pollinators.

Buzz Pollination

Many plant species, including tomatoes, blueberries and kiwifruit, hold their pollen tightly in their anthers. Most of these species have hollow anthers with a small pore on the end (poricidal anthers) through which the pollen is ejected after sonication or "buzzing" by a bee. This is most likely an adaptation to limit pollen thieves and maximise pollen dispersal through legitimate pollinating bees. The European honeybee cannot buzz pollinate but many of our native bees, including the Blue Banded Bee in this photo, do buzz pollinate, making them better pollinators for some plant species.

Photo: Jenny Thynne

Some Common Australian Native Bees

Leafcutter Bees

Leafcutter bees are in the genus *Megachile* and are common in urban areas and gardens. Females have sturdy mouthparts for cutting leaves that are used to line their nest. The presence of leafcutter bees is often indicated by the neat circular holes they cut in leaves and some common species targeted are ginger and roses. There are approximately 50 species in Australia. Most leafcutter bees nest in existing holes or crevices in timber and twigs, but some species burrow into the soil.

Resin Bees

Resin bees are also in the genus *Megachile* and are closely related to leafcutter bees. Resin bees build their nests in existing holes in wood (usually made by wood boring insects), and then use plant resins, mud or leaf pulp to line and seal their nests. Resin bees are common throughout mainland Australia and will readily nest in artificial nests. Resin bees can be distinguished by their cylindrical (cigar-shaped) abdomens, whereas leafcutter bees have a pointy, leaf-shaped, abdomen.

Carpenter Bees

There are nine species of Carpenter Bee in Australia, all in the genus *Xylocopa*. The Carpenter Bees can be separated into two main groups; the Green Carpenter Bees (2 spp.), and the Yellow and Black Carpenter Bees (7 spp.). Carpenter Bees use their strong mandibles to excavate a nesting tunnel into soft decaying wood. They are also often found nesting in *Xanthorrhoea* (Grass Trees) inflorescence spikes. Carpenter Bees "buzz" pollinate and are important pollinators of some plants.

Amegilla Bees

The genus *Amegilla* includes some of our most commonly seen bee species and includes the Blue Banded Bees and Teddy Bear Bees. There are approximately 60 spp. across mainland Australia. *Amegilla* bees are also "buzz" pollinators and have potential as pollinators of greenhouse tomatoes. *Amegilla* bees nest in burrows made in soft soil and will also nest in artificial mud nests. Blue Banded Bee nests are commonly parasitised by Cuckoo Bees (Genus *Thyreus*).

Masked Bees

Australia has the most abundant and diverse assemblage of Masked Bees (Family *Colletidae*) in the world. The Masked Bees are common throughout Australia and are associated with trees from the family *Myrtaceae*. Species from the genus *Hylaeus* are common and can be identified by their yellow/white markings on the their back and face. The Masked Bees line and cap their nests with a transparent cellophane-like lining and are sometimes called Cellophane Bees.

Stingless Bees

There are 10 species of stingless social bees in Australia, all in the genera *Tetragonula* and *Austroplebeia*. Stingless Bees are restricted to the warmer areas of Australia and live in complex colonies containing 1000's of individuals, each with specific roles that are determined by caste (Queen, worker and drone). Hives are commonly found in tree hollows and the species *Tetragonula carbonaria* has been successfully domesticated and used as a pollinator of several crops.

The role of native pollinators in Australian agriculture

European honeybees are easily managed, good pollinators for many crops, and are widely available – so why consider alternative native pollinators?

1. Risk management

   Exotic pests and diseases could quickly, and radically impact on the ability of European honeybees to provide the pollination services required by farmers. Native pollinators provide a buffer to any such declines and act as a type of "pollinator insurance" for farmers.

2. Production benefits

   For some crops, native pollinators (bees and flies) actually perform better than European honeybees. By ignoring the role of these other pollinators we miss out on opportunities to increase the productivity of these crops.

3. Biodiversity benefits

   Our diverse Australian flora depends on a diversity of pollinators for its successful reproduction and ongoing health. Foraging by honeybees, both feral and managed, displaces many native nectar and pollen dependant species and can reduce seed set in some native plant species. By creating pollinator friendly farms, we can improve farm productivity and the local environment.

Native pollinators – good for the environment and the farm.

Benefits and limitations of native pollinators to farm production

Research into the role of native pollinators in Australian agriculture has, in the past, been limited – although this does appear to be changing.

The lack of widespread studies also creates difficulties for agricultural extension staff wanting to clearly state the importance of native pollinators to the Australian farming community. Even with this lack of crop specific research there are still some general benefits and limitations that can be confidently stated.

Key benefits

Native pollinators often collect and transfer pollen as efficiently as European honeybees. Individually honeybees are no better at pollination than many native pollinators and their inability to buzz pollinate severely limits their ability to pollinate some species. This is understandable as it is hard to expect one bee species to perform equally well for all plant species!

There is a clear link between having a diverse pollinator community and increases in fruit set and quality. Pollinator diversity results in more pollen being delivered to the stigma (reducing pollen limitation) and increases outcrossing as pollen is sourced from a number of donors. Consequently, increasing the number and diversity of native pollinators has a much larger effect on productivity than a similar increase in European honeybees.

Key limitations

Native pollinators are often less common and abundant, and this limits their effectiveness as crop pollinators. While native pollinators may be equally able to collect and transfer pollen their low numbers in many agricultural landscapes limits their effectiveness as pollinators. By contrast European honeybees can be maintained at artificially high concentrations, allowing them to outnumber and outperform native pollinators in many agricultural settings.

Solitary bees often have short foraging seasons that are highly synchronised with their host species. This means that it can take a number of native species to cover the daily and seasonal availability of honeybees. Native pollinators can also be hard to manage and our lack of knowledge about their basic biology makes it difficult to artificially increase their abundance.

How to improve the native bee habitat on your farm?

A few simple changes to farm management practices will help support native bees on your property. Native bees have two essential habitat requirements – access to safe nesting sites and a continuous supply of nectar and pollen during the breeding season.

Nesting sites

Native bees nest in a variety of substrates including, soil, decaying wood, pithy stems and tree hollows. Providing a diversity of micro-habitats will increase the nesting opportunities on your property and support a greater diversity of bees.

Ground nesting bees:

Ground nesting bees, such as Blue Banded Bees, require access to undisturbed soil that is on well drained and open ground. These bare areas can often be found under raised farm buildings, under tree crops, on paddock margins and in adjoining areas of native bush.

Cavity nesting bees:

Established windbreaks and areas of remnant native vegetation will often have a number of old, decaying trees and pithy stems that are commonly used by cavity nesting solitary bees. Mature trees will also have small hollows that are ideal for native stingless social bees. By leaving dead trees standing, and fallen timber on the ground you will increase the availability of nesting sites on your farm. These areas of native vegetation will also provide important nectar and pollen resources for bees when your crops are not flowering.

Providing artificial nest sites:

Artificial nesting blocks can also be created for some species. For ground nesting species these can be made from rammed mud blocks made from a mixture of 3 parts sand and 1 part clay. This mixture can be pressed into the hollow sections of Besser bricks or rectangular PVC downpipe (200-250mm long) to help avoid cracking. Before the mix has dried, push a number of "starter" holes into the block with a tent peg. Blocks similar to these have been successfully used in trials of Blue Banded Bees in tomato hothouses.

Artificial nest blocks are one way to increase nesting habitat on your property, although allowing for natural nesting sites can often be just as effective.

Artificial cavity nesting blocks can be made by drilling 5 – 7mm dia. holes (100 – 150mm deep) into timber blocks, fence posts or dead trees. Some species prefer pithy stems such as small diameter bamboo or dry lantana stems. These can be cut to approx. 250mm long and then bundled together with wire. For more information on artificial nest blocks refer to the links in the *Further Reading* section.

Nectar and pollen resources

Many native bees will require nectar and pollen for a longer period than your crops can provide. This makes it important to retain areas of remnant vegetation and other flowering plants around your property. To encourage a diversity of bee species you need to provide a diversity of flower types with overlapping flowering times. This will provide continuous floral resources during the breeding season.

For some high value crops, new pollinator specific plantings may be worthwhile. Some American tomato and blueberry growers have successfully incorporated pollinator hedgerows into their farms. These hedgerows are filled with a variety of flowering plants that help bring native bees into large areas of intensively managed farmland.

A pollinator hedgerow in an American vegetable farm. These thin, pollinator specific plantings, provide important floral resources.

Areas of vegetation also provide essential nesting materials such as natural resins, mud and plant materials used to build and line nest cavities. While some species are able to substituent one material for another, some require specific materials to nest.

Pesticides on the farm

Pesticides, and in particular insecticides, can be harmful to many beneficial insects, including bees. Insecticide use may not necessarily kill the native bees on your property, but they will reduce their

performance. To avoid these impacts minimise spraying when bees are most active. This includes periods when target crops are in full bloom and times of the day when bees are most active. When you have a choice of pesticides always use the product with the lowest toxicity rating.

Recommendations for landholders

There are strong arguments for considering the requirements of native pollinators on your farm. Managing the natural areas of your property for the benefit of biodiversity, and the ecosystem services these areas provide, can have significant production benefits. A healthy and diverse community of pollinators can provide an effective and free source of pollination on your farm and improving bee habitat and boosting this free pollination service can be as simple as:

- **Providing access to safe nesting sites**
- **Having a diversity of flowering plants that flower over a long period**
- **Protecting areas of remnant vegetation on your property**
- **Minimising pesticides use when and where bees are active**

Adopting these management approaches will give you the best chance of attracting and maintaining a diverse pollinator community on your property.

Further Reading

The Australian Native Bee Book
Tim Heard, 2015.
Available from Tim's website http://www.sugarbag.net/

Attract Bees and **Bee Wall and Habitat**
Valley Bees, Mary Valley, QLD.
Two excellent publications on Australian native bees and artificial nesting blocks. Available from:
http://mrccc.org.au/valley-bees/

Australian Native Bee Research Centre
The original native bee website. Full of information on both solitary and social native bees.
http://www.aussiebee.com.au/

Bee Friendly
A planting guide for European honeybees and Australian native bees.
https://rirdc.infoservices.com.au/downloads/12-014

AN Bees
A long established Yahoo Group on native bees. For more information, go to:
http://www.australiannativebees.com/

Australian Native Bee Network Facebook Group
A great place to share photos and learn about Australian native bees.
https://www.facebook.com/groups/australiannativebeenetwork/

Xerces Society for Invertebrate Conservation
An excellent American website on pollinator conservation with great publications on providing native bee habitat on farms. Although the content is predominantly North American many of the resources provided are equally relevant to Australia.
http://www.xerces.org/

For more information on the Jaliigirr Biodiversity Alliance go to:
http://www.greateasternranges.org.au/our-partners/ger-regional-partnerships/jalliigirr-biodiversity-alliance/

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Australian Government | National Landcare Programme

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